INSTRUCTION MANUAL

Clegg APOLLO SIX

6 Meter Linear Amplifier

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APOLLO

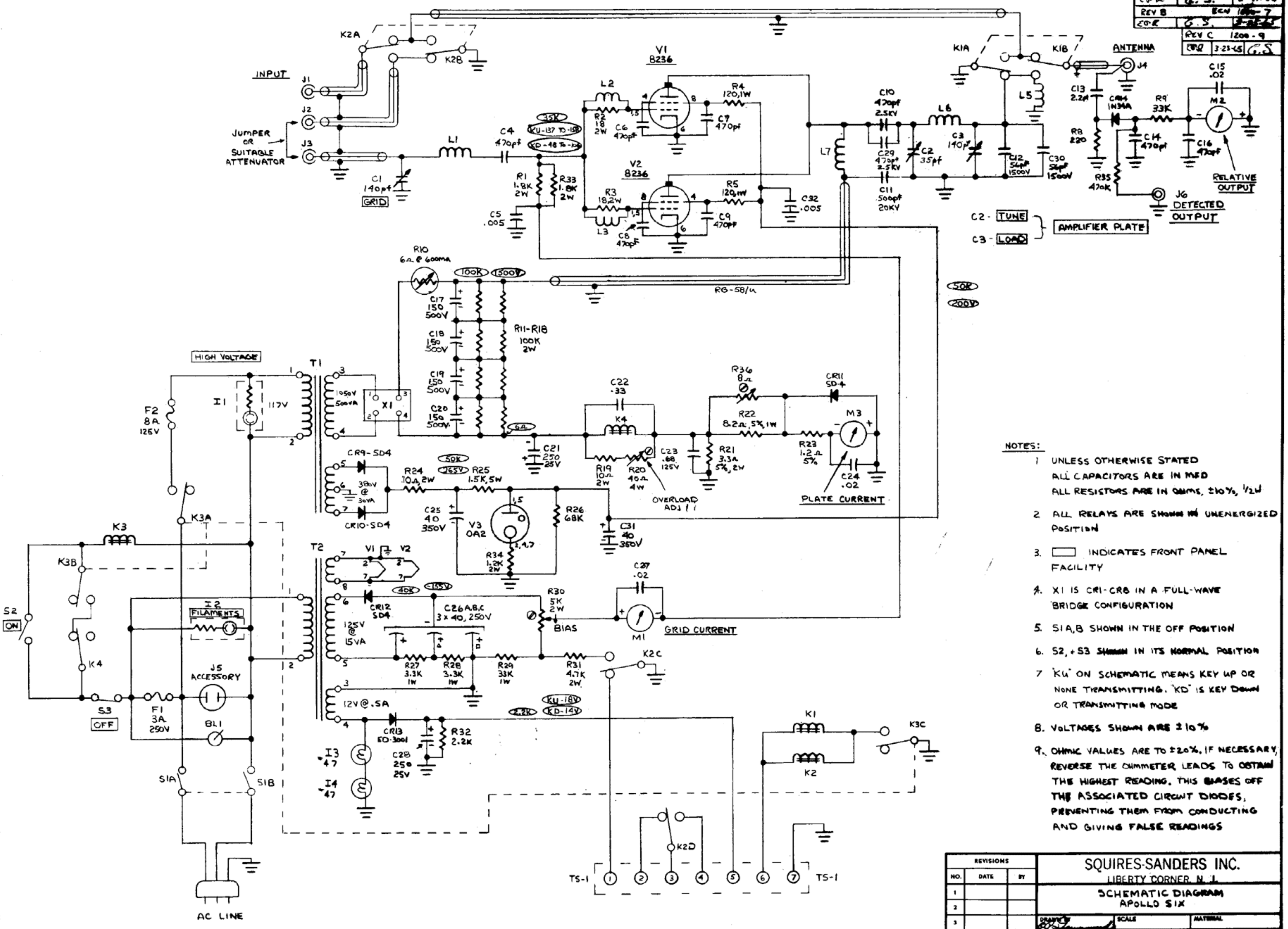
6 METER LINEAR AMPLIFIER

PARTS LIST

ITEM	DESCRIPTION	PART NUMBER
BL1	BLOWER, MOTOR	450-002
C1	CAPACITOR, VARIABLE, 6.2 pf - 142 pf	110-030
C2	CAPACITOR, VARIABLE, 8.5 pf - 32 pf	110-031
C3	CAPACITOR, VARIABLE, 6.2 pf - 142 pf	110-030
C4	CAPACITOR, SILVERED MICA, 470 pf, 500 V, 10%	103-122
C5	CAPACITOR, DISC CERAMIC, .005 MFD, + 80 - 20%, 500 V	102-070
C6	CAPACITOR, DISC CERAMIC, 470 pf, ± 10%, 1 KV	101-003
C7	CAPACITOR, DISC CERAMIC, 470 pf, ± 10%, 1 KV	101-003
C8	CAPACITOR, DISC CERAMIC, 470 pf, ± 10%, 1 KV	101-003
C9	CAPACITOR, DISC CERAMIC, 470 pf, ± 10%, 1 KV	101-003
C10	CAPACITOR, SILVERED MICA, 470 pf, 2.5 KV, 5%	103-130
C11	CAPACITOR, MICA "KNOB", 500 pf, 20 KV	103-002
C12	CAPACITOR, SILVERED MICA, 56 pf, 1.5 KV, 5%	103-131
C13	CAPACITOR, DISC CERAMIC, 2.2 pf, NPO, 1 KV	100-104
C14	CAPACITOR, DISC CERAMIC, 470 pf, ± 10%, 1 KV	101-003
C15	CAPACITOR, DISC CERAMIC, .02 MFD, + 80 - 20%, 500 V	102-056
C16	CAPACITOR, DISC CERAMIC, 470 pf, ± 10%, 1 KV	101-003
C17	CAPACITOR, ELECTROLYTIC, 150 MFD @ 500 V	108-004
C18	CAPACITOR, ELECTROLYTIC, 150 MFD @ 500 V	108-004
C19	CAPACITOR, ELECTROLYTIC, 150 MFD @ 500 V	108-004
C20	CAPACITOR, ELECTROLYTIC, 150 MFD @ 500 V	108-004
C21	CAPACITOR, ELECTROLYTIC, 250 MFD @ 25 V	107-011
C22	CAPACITOR, MYLAR, .33 MFD, ± 10%, 125 V	105-306
C23	CAPACITOR, MYLAR, .68 MFD, ± 10%, 125 V	105-307
C24	CAPACITOR, DISC CERAMIC, .02 MFD, + 80 - 20%, 500 V	102-056
C25	CAPACITOR, ELECTROLYTIC, 40 MFD @ 350 V	107-032
C26	CAPACITOR, ELECTROLYTIC, 40 - 40 - 40 MFD @ 250 V	108-206
C27	CAPACITOR, DISC CERAMIC, .02 MFD, + 80 - 20%, 500 V	102-056
C28	CAPACITOR, ELECTROLYTIC, 250 MFD @ 25 V	107-011
C29	CAPACITOR, SILVERED MICA, 470 pf, 2.5 KV, 5%	103-130
C30	CAPACITOR, SILVERED MICA, 56 pf, 1.5 KV, 5%	103-131
C31	CAPACITOR, ELECTROLYTIC, 40 MFD, 350 V	107-032
C32	CAPACITOR, DISC CERAMIC, .005 MFD, + 80 - 20%, 500 V	102-070
CR1	DIODE, SILICON, ERIE ED 3010	142-003
CR2	DIODE, SILICON, ERIE ED 3010	142-003
CR3	DIODE, SILICON, ERIE ED 3010	142-003
CR4	DIODE, SILICON, ERIE ED 3010	142-003
CR5	DIODE, SILICON, ERIE ED 3010	142-003
CR6	DIODE, SILICON, ERIE ED 3010	142-003
CR7	DIODE, SILICON, ERIE ED 3010	142-003
CR8	DIODE, SILICON, ERIE ED 3010	142-003
CR9	DIODE, SILICON, DIODE INC. SD4	142-004
CR10	DIODE, SILICON, DIODE INC. SD4	142-004
CR11	DIODE, SILICON, DIODE INC. SD4	142-004
CR12	DIODE, SILICON, DIODE INC. SD4	142-004
CR13	DIODE, SILICON, ERIE ED 3001S	142-002
CR14	DIODE, GERMANIUM, IN34A	141-001
F1	FUSE, 3 AG, 3 AMP, 250 V	160-021
F2	FUSE, 3 AG, 8 AMP, 125 V	160-023
I1	LAMP ASSEMBLY	158-001
I2	LAMP ASSEMBLY	158-001
I3	LAMP, INCANDESENT - FROSTED	150-101
I4	LAMP, INCANDESENT - FROSTED	150-101
J1, J2, J3, J6	1 PIN PHONE JACK	293-003
J4	UHF CHASSIS MOUNT	291-101
J5	2 PRONG - RECEPTACLE	293-014

ITEM	DESCRIPTION	PART NUMBER
L1	INDUCTOR, 4T #14, 7/16 DIA. x 7/16 LONG	
L2	INDUCTOR, 2T #22 ON 10 ohm, 2 W, RESISTOR	190-022
L3	INDUCTOR, 2T #22 ON 10 ohm, 2 W, RESISTOR	190-022
L4	NOT USED	
L5	CHOKE, RF, 7μh	190-004
L6	INDUCTOR, 3T #10 TINNED, WRAPPED ON 9/16" ROD	191-016
L7	CHOKE, 42T #24N CLOSE SPACE - CCW	190-020
M1	METER, 0 - 3 ma. DC, 220 ohm ± 20%	409-011
M2	METER, 0 - 1 ma. DC, 950 ohm ± 20%	409-012
M3	METER, 0 - 200 ma. DC, 0.5 ohm ± 5%	409-013
K1	RELAY, DPDT, W/12 VDC COIL	172-003
K2	RELAY, 4PDT, W/12 VDC COIL	174-002
K3	RELAY, 3PDT, W/115 VAC COIL	173-002
K4	RELAY, SPST, W/7-1/2 ohm DC RES, 400 ma. DC	171-002
R1	RESISTOR, FIXED COMPOSITION, 1.8 K, 10%, 2 W	227-182
R2	RESISTOR, FIXED COMPOSITION, 18 ohm, 10%, 2 W	227-180
R3	RESISTOR, FIXED COMPOSITION, 18 ohm, 10%, 2 W	227-180
R4	RESISTOR, FIXED COMPOSITION, 120 ohm, 10%, 1W	225-121
R5	RESISTOR, FIXED COMPOSITION, 120 ohm, 10%, 1W	225-121
R6	NOT USED	
R7	NOT USED	
R8	RESISTOR, FIXED COMPOSITION, 220 ohm, 10%, 1/2 W	223-221
R9	RESISTOR, FIXED COMPOSITION, 33 K, 10%, 1/2 W	223-333
R10	RESISTOR, GLOBAR, 6 ohms @ .6 AMP	249-003
R11	RESISTOR, FIXED COMPOSITION, 100 K, 10%, 2 W	227-104
R12	RESISTOR, FIXED COMPOSITION, 100 K, 10%, 2 W	227-104
R13	RESISTOR, FIXED COMPOSITION, 100 K, 10%, 2 W	227-104
R14	RESISTOR, FIXED COMPOSITION, 100 K, 10%, 2 W	227-104
R15	RESISTOR, FIXED COMPOSITION, 100 K, 10%, 2 W	227-104
R16	RESISTOR, FIXED COMPOSITION, 100 K, 10%, 2 W	227-104
R17	RESISTOR, FIXED COMPOSITION, 100 K, 10%, 2 W	227-104
R18	RESISTOR, FIXED COMPOSITION, 100 K, 10%, 2 W	227-104
R19	RESISTOR, FIXED COMPOSITION, 10 ohm, 10%, 2 W	226-100
R20	RESISTOR, WIREWOUND, 40 ohm, 4 W LINEAR	244-001
R21	RESISTOR, FIXED COMPOSITION, 3.3 ohm, 5%, 2 W	226-033
R22	RESISTOR, WIREWOUND, 8.2 ohm, 5%, 1 W	224-082
R23	RESISTOR, WIREWOUND, 1.2 ohm, 5%, 1 W	224-012
R24	RESISTOR, FIXED COMPOSITION, 10 ohm, 10%, 2 W	226-100
R25	RESISTOR, WIREWOUND, 1.5 K, 10%, 5 W	232-012
R26	RESISTOR, FIXED COMPOSITION, 68 K, 10%, 1/2 W	223-683
R27	RESISTOR, FIXED COMPOSITION, 3.3 K, 10%, 1 W	225-332
R28	RESISTOR, FIXED COMPOSITION, 3.3 K, 10%, 1 W	225-332
R29	RESISTOR, FIXED COMPOSITION, 33 K, 10%, 1 W	225-333
R30	RESISTOR, VARIABLE, 5 K, 2 W, 20% LINEAR	243-008
R31	RESISTOR, FIXED COMPOSITION, 4.7 K, 10%, 2 W	227-472
R32	RESISTOR, FIXED COMPOSITION, 2.2 K, 10%, 1/2 W	223-222
R33	RESISTOR, FIXED COMPOSITION, 1.8 K, 10%, 2 W	227-182
R34	RESISTOR, FIXED COMPOSITION, 1.2 K, 10%, 2 W	227-122
R35	RESISTOR, FIXED COMPOSITION, 470 K, 10%, 1/2 W	223-474
R36	RESISTOR, WIREWOUND, VARIABLE, 8 ohm, 2 W, 20% LINEAR	247-001
S1	SWITCH, TIPPETTE DPST, 15 AMP, SNAP-IN, SMALL	285-001
S2	SWITCH, TIPPETTE SPST, 6 AMP, SNAP-IN, SMALL	285-002
S3	SWITCH, TIPPETTE SPST, 6 AMP, SNAP-IN, SMALL	285-003
T1	TRANSFORMER, PLATE AND SCREEN	601-016
T2	TRANSFORMER, FILAMENT, BIAS, RELAY	600-001
V1	TUBE, ELECTRON, 8236	218-002
V2	TUBE, ELECTRON, 8236	218-002
V3	TUBE, ELECTRON, OA2	210-001

REV A		ECN 1200-5
EOR	G.S.	2-11-65
REV B		ECN 1[illegible]-7
EOR	G.S.	[illegible]
REV C		1200-9
EOR	3-23-65	G.S



NOTES:

1 UNLESS OTHERWISE STATED
ALL CAPACITORS ARE IN MFD
ALL RESISTORS ARE IN OHMS, ±10%, 1/2W

2 ALL RELAYS ARE SHOWN IN UNENERGIZED POSITION

3. ▭ INDICATES FRONT PANEL FACILITY

4. X1 IS CR1-CR8 IN A FULL-WAVE BRIDGE CONFIGURATION

5. S1A,B SHOWN IN THE OFF POSITION

6. S2, + S3 SHOWN IN ITS NORMAL POSITION

7 "KU" ON SCHEMATIC MEANS KEY UP OR NONE TRANSMITTING. "KD" IS KEY DOWN OR TRANSMITTING MODE

8. VOLTAGES SHOWN ARE ±10%

9. OHMIC VALUES ARE TO ±20%. IF NECESSARY, REVERSE THE OHMMETER LEADS TO OBTAIN THE HIGHEST READING. THIS BIASES OFF THE ASSOCIATED CIRCUIT DIODES, PREVENTING THEM FROM CONDUCTING AND GIVING FALSE READINGS

REVISIONS		
NO.	DATE	BY
1		
2		
3		
4		
5		

SQUIRES-SANDERS INC.
LIBERTY CORNER, N. J.

SCHEMATIC DIAGRAM
APOLLO SIX

DRAWN BY		SCALE	MATERIAL
CHKD RS	DATE 11/29/65	DRAWING NO. C10-621	REV C
TRACED	APPD GS 3-24-65		

I. DESCRIPTION

A. General

The APOLLO for 6 meters is a high performance linear amplifier designed primarily for use with the Clegg VENUS SSB transceiver and with or without the Clegg SS BOOSTER. (The Clegg SS BOOSTER provides RF speech clipping to the effect of up to 20 db increase in effectiveness over that of the VENUS or VENUS/APOLLO alone.) The APOLLO matches the VENUS in styling and size and features simplicity of control (Linear on, Linear off) when used with the VENUS.

Sideband exciters other than the VENUS may also be used to drive the APOLLO as noted in detail later.

The APOLLO may also be used as a linear amplifier for AM exciters of modest output, but at reduced output over operation in sideband mode.

B. Specifications and Features

1. Power input is 675 watts peak DC.
2. Parallel final tubes pi-network coupled for 50-70 ohm output.
3. Power supply built in, using the latest solid state techniques.
4. Three illuminated meters continuously metering critical circuits for easy tune-up.
    a) Grid Current
    b) Relative output
    c) Plate Current
5. Instant Exciter/Linear selection when used with the VENUS. Other units without any available auxiliary relay contacts will require an external relay.
6. All functions controlled from front panel when used with the VENUS.
7. Attractively styled cabinet matches the VENUS.
8. Tube line up: (2) 8236
    (1) OA2
9. Power requirements: 115 VAC, 60 cycle, 500 VA (approx. at full load).
10. Physical Dimensions: 15" wide 7" high 10-1/2" deep.
11. Weight: 35 lbs.

II. INSTALLATION

A. Unpacking

The APOLLO has been packed with adequate internal carton bracing and cushioning to withstand normal handling in shipment to common carriers. Examine the carton exterior for signs of severe damage (crushing, piercing, etc.) In the event of obvious serious damage, examine the equipment carefully to determine the extent of internal damage, save packing material and make claim against transportion company.

Check all front panel controls for freedom of action and observe that all tubes are firmly seated in their sockets. Complete and mail the equipment registration card.

B. General

The APOLLO installation will necessarily vary depending on the nature of the exciter used, the physical space available at the operating position, the availability of an RF Monitoring Scope, etc. In any event, the following factors should be considered.

1. The APOLLO should be located sufficiently close to the operating position to permit convenient observation of the panel meters.

2. In the interest of maximum tube and component life it is recommended that the right side and back of the APOLLO be at least six inches from any major obstruction to air flow. The cabinet top must be left clear of obstructions.

3. A well regulated source of 110 - 120 VAC, 60 cps should be used. Line current demand may be up to 10 amperes and the typical ham shack service with numerous pieces of equipment operated from 1 or 2 conventional #14 wired base receptacles will be quite inadequate for proper performance with the APOLLO (or any other similar power linear).

4. Optimum performance with any single sideband equipment is most easily obtained and maintained by use of some form of instantaneous peak visual monitoring. With high powered units such as the APOLLO the availability of such a monitor is almost mandatory. The APOLLO is provided with an envelope detector J6 for such monitoring with virtually any type of scope. An alternate is to utilize a Heath Monitor Scope in the transmission line.

5. The exciter should be capable of 8 watts peak output without distortion. It must be remembered that the APOLLO yields as much as 16 db gain of all outputs, desired and undesired, coming from the exciter. Many low power exciters that have distortion products and other spurious content that are reasonably acceptable when operated "barefoot"become quite unacceptable when they are amplified by 3 "S units".

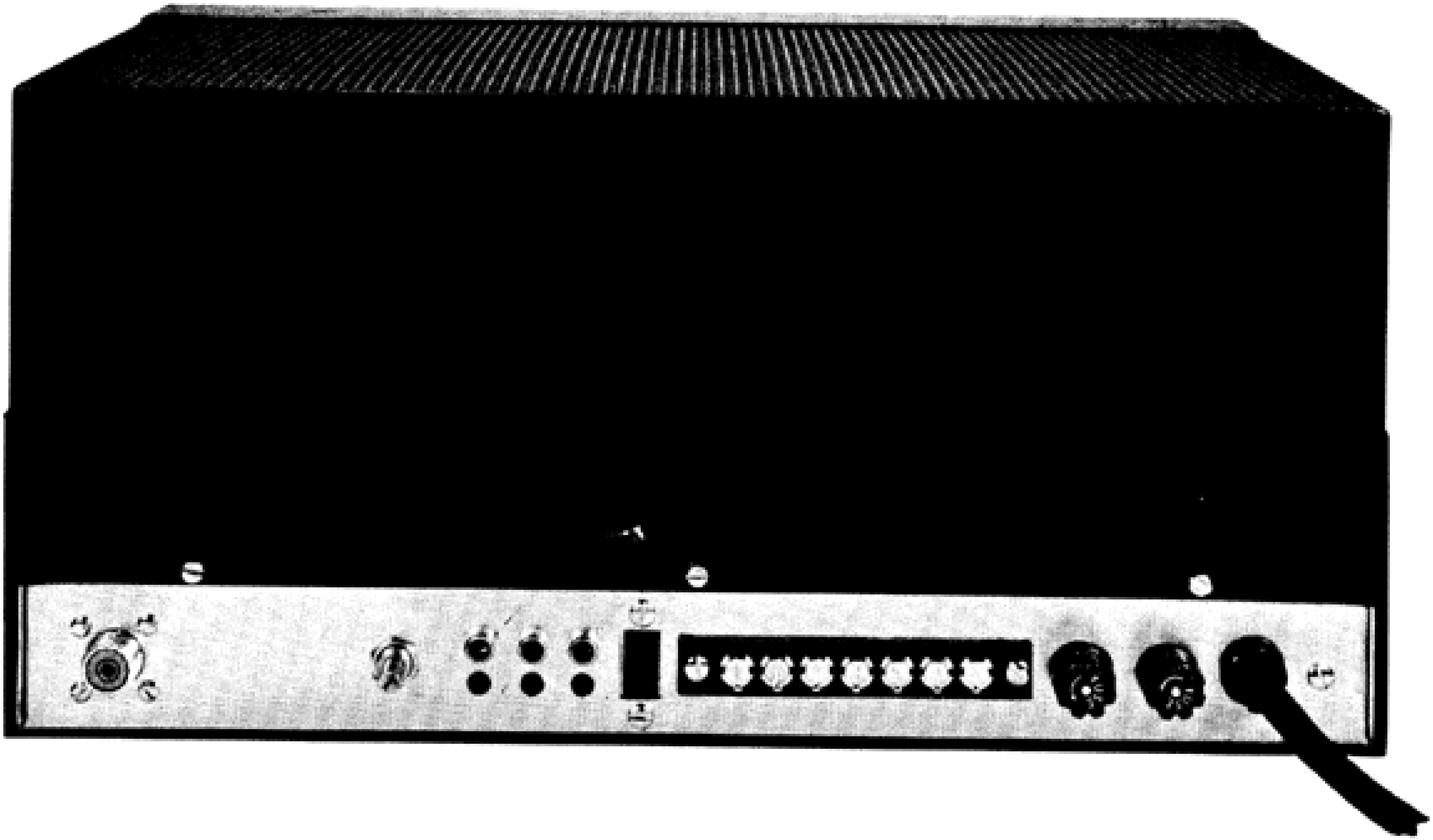


FIG. 2 – APOLLO REAR VIEW

a. Remove jumper temporarily from J2 and J3 at rear of APOLLO.
b. Turn HIGH VOLTAGE ON.
c. Turn 99'er to SEND position.
d. Adjust BIAS control at rear of APOLLO for 70 - 75 ma PLATE CURRENT reading.
e. Switch 99'er to RECEIVE.
f. Observe that PLATE CURRENT drops to zero.
g. Switch OFF HIGH VOLTAGE.
h. Reconnect jumper at J2 - J3.

b) APOLLO TUNE-UP with 99'er

(1) Adjust 99'er for maximum output in "straight through" mode, (i.e. APOLLO connected but HIGH VOLTAGE OFF).

(2) Set AMPLIFIER PLATE LOAD TO full counter clockwise, minimum loading, #1 position.

(3) Set AMPLIFIER PLATE TUNE to full clockwise, #10 position.

(4) Set GRID control to full counter clockwise, #1 position.

(5) Apply high voltage to APOLLO (by momentarily depressing HIGH VOLTAGE ON switch).

(6) Switch 99'er to SEND position.

(7) Adjust APOLLO GRID control for 180 ma PLATE CURRENT.

(8) Adjust AMPLIFIER PLATE TUNE control for minimum plate current.

(9) Adjust both AMPLIFIER PLATE controls together for maximum RELATIVE OUTPUT while maintaining PLATE CURRENT between 180 and 200 ma by means of APOLLO GRID control.

(10) Final adjustment should produce between 60 and 75 watts carrier output from APOLLO with approximated 180 ma plate current and neither AMPLIFIER PLATE control at an extremity of its range.

(11) 99'er modulation should be adjusted so that APOLLO plate current shows the slightest upward movement on modulation peaks.

III. OPERATION

A. SET UP-APOLLO with the VENUS

1. Switch VENUS to AC ON and tune up VENUS in normal manner for SSB operation observing that RELATIVE OUTPUT meter on APOLLO behaves in similar manner (but about 1/8 scale reading) to the OUTPUT meter on VENUS. Be sure the carrier is properly supressed.

2. Return VENUS to receive mode and establish continuity of RF cabling by ascertaining that VENUS receiver functions are normal.

3. Depress FILAMENT switch on APOLLO. Allow at least 1 minute warm up time.

4. Apply High Voltage on APOLLO by momentarily depressing HIGH VOLTAGE ON switch.

5. Switch VENUS to CW position. (Make sure KEY is closed or KEY jack on VENUS is otherwise shorted.) Note that the APOLLO bias is 75 - 85 ma. See page 5, C.8.

6. Gradually insert the carrier on the VENUS by advancing Carrier Level Control until either:

   a) Plate current increases to 150 ma on APOLLO, or
   b) Plate current increases to 100 ma on VENUS.

7. Tune GRID control on APOLLO for MAX. plate current. If plate current exceeds 200 ma reduce CARRIER LEVEL at VENUS.

8. Adjust both APOLLO AMPLIFIER PLATE controls for maximum RELATIVE OUTPUT while maintaining plate current between 150 and 180 ma by readjusting the CARRIER LEVEL on VENUS as necessary.

9. After obtaining the highest indicated RELATIVE OUTPUT for 200 ma plate current observe that neither of the AMPLITIER PLATE TUNE or LOAD controls is at an extreme end of its range. (In the event either control is at its extremity do not proceed further before correcting excessive SWR on your antenna system.)

10. BRIEFLY increase CARRIER LEVEL at VENUS until:

    a) APOLLO GRID CURRENT is approximately 1-1/2 ma, or
    b) APOLLO PLATE CURRENT is 450 ma, WHICH EVER OCCURS FIRST, AND QUICKLY ADJUST AMPLIFIER PLATE TUNE ON APOLLO slightly for maximum relative output. Switch HIGH VOLTAGE off on Apollo. Turn CARRIER LEVEL CONTROL fully counter-clockwise beyond the switch click. Null carrier with the BALANCE CONTROL.
    c) Return the Venus to receive by removing the SPEECH GAIN CONTROL from CW position. You are now ready for SSB operation. Read on.

B. Operating notes for VENUS/BOOSTER

The following notes are supplied to facilitate operation with the VENUS:

1. Normal tune-up operation of the APOLLO will be indicated by GRID CURRENT of approximately 1.5 ma, PLATE CURRENT of 450 ma (650 watts) AND output of 325 watts. These are single tone or carrier meter readings and should NOT be sustained for periods of more than 10 - 15 seconds during tune-up and test.

2. Normal voice operation of the APOLLO without SPEECH BOOSTING will be indicated by an occassional flicker of the GRID CURRENT meter, PLATE CURRENT average of 140 to 220 ma depending on operator's voice characteristic.*

3. Normal voice operation of the APOLLO with SS BOOSTER - VENUS exciter will be approximately .5 to 1.3 ma GRID CURRENT and 180 to 350 ma PLATE CURRENT depending on amount of BOOSTER clipping employed.

   NOTE: Due to the higher average power of the VENUS 6 transceiver with the SS BOOSTER, the use of one of the attenuators shown on page 17 is necessary when driving the APOLLO linear amplifier. Three choices are shown for your consideration. Circuit 50 - 25 is preferred. This is available as part of Squires-Sanders #800-803 VENUS/APOLLO Interconecting Kit from your distributor.

4. The APOLLO can be deactivated instantaneously, still permitting the VENUS to "play through" normally, by merely depressing the HIGH VOLTAGE OFF switch momentarily. Output power will normally drop about 2-1/2 S units and provide a means of compliance with legal requirements for local operation where full power is not required.

5. Optimum sideband performance can best be obtained by adjusting drive to the APOLLO by means of the PEAK POWER control of the SS BOOSTER while observing for "flat topping" with an RF Scope in the ANT line or with a conventional scope viewing the envelope detector output at J6. The APOLLO is designed to go through comparatively smooth transition from an ultra-linear mode and very low distortion products to a higher output, higher efficiency mode. When drive is maintained at the point just preceeding visible "flat topping" efficiency and power output will be high and distortion products will meet acceptable standards for commercial services. Since the characteristics of the SS BOOSTER are such as to provide instantaneous peak limiting to the drive signal if furnishes the means to operate at the optimum level.

* If OVERLOAD RELAY turns the high voltage off, reset by depressing the HIGH VOLTAGE ON switch. This indicates excessive plate current. (over 600 ma. peaks)

C. Operation with 50 MC SSB EXCITERS other than the VENUS

1. There appear to be no limitations to operation of the APOLLO with any of the currently available 50 MC SSB exciters.

2. The operator, in making an APOLLO installation with other equipment, should examine the control circuits shown in the APOLLO schematic and described under THEORY OF OPERATION. Numerous methods of utilizing the flexible control functions will become evident to meet the specific application.

3. Transmit-Receive switching information isolated from ground must be available to present a closed circuit condition across 5 to 6 of TS-1 during transmit and open circuit during receive.

4. The normal antenna relay previously used for the exciter can retain just that function upon addition of the APOLLO.

5. Where exciter output is less than 8 watts the APOLLO will still serve to produce up to 16 db output gain. That is, a 2 watt driver would be boosted to as much as 80 watts output and a 5 watt driver to 200 watts output.

6. Where exciter output is in excess of 40 or 50 watts a suitable 50 ohm attenuator can be inserted between J2 and J3 on the APOLLO. Design of such an attenuator has been covered in the available literature.

7. Squires-Sanders will be pleased to provide information on installation and operation for the APOLLO with any other units upon receipt of the manufacturers instruction manual for the specific exciter.

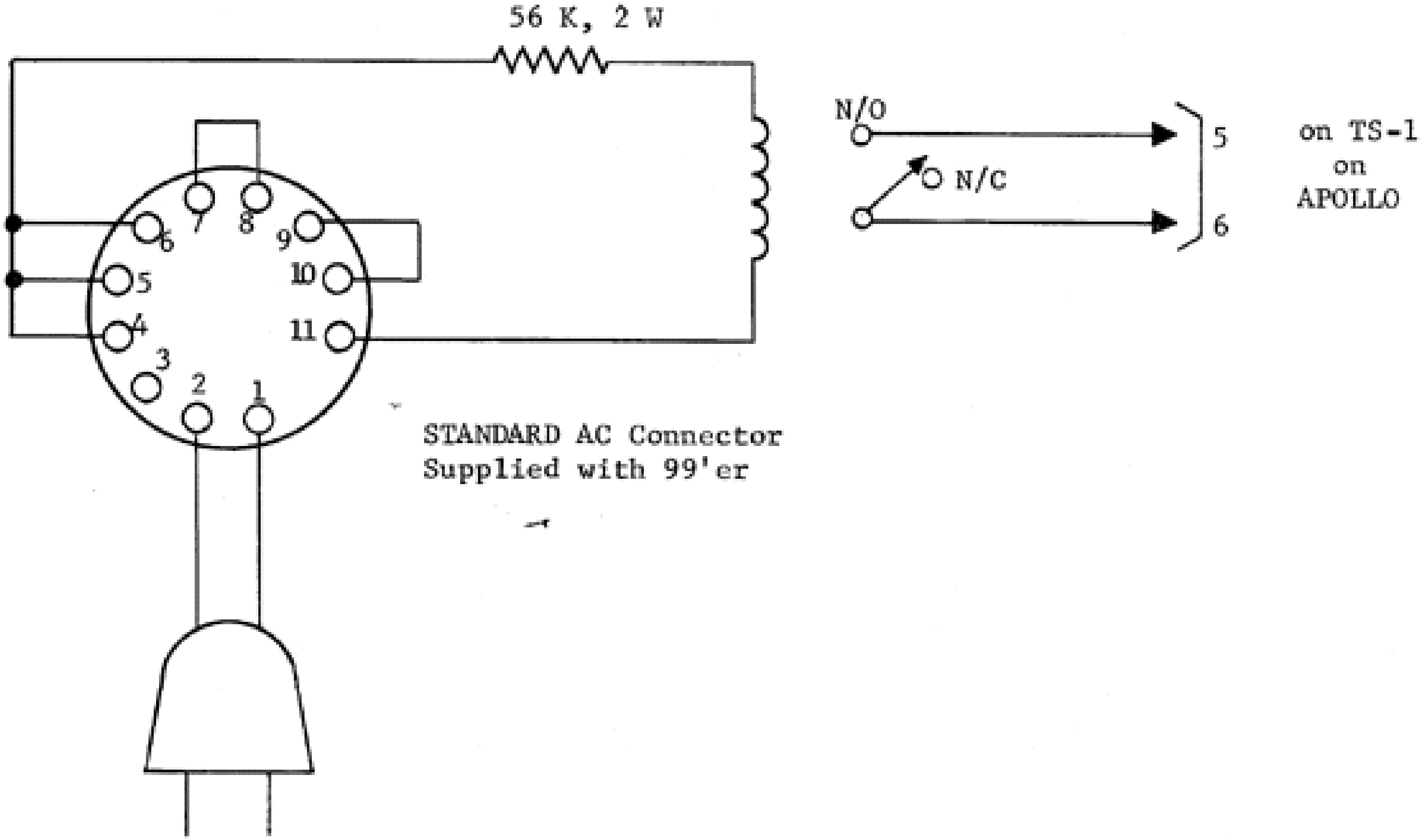
D. Operation with AM Drive

1. The APOLLO is capable of furnishing significant power gain when used with conventional AM units (such as the 99'er – see below) in the 3 - 15 watt power class. (It is useable, of course, with the VENUS or other sideband exciters that have provision for inserting carrier.) Most difficulty in the application of the APOLLO with standard AM transmitter will be in adjusting the drive to the proper level since most such units do not include provisions for power output control. This problem is most readily solved by adjusting the AM transmitter for best performance into a 50 ohm antenna and then inserting sufficient attenuation in the APOLLO grid circuit (at J2 - J3) for correct drive.

2. AM operation with the 99'er. The following information, while specifically directed at marrying the APOLLO and the 99'er, also will be applicable to other AM transmitters or transceivers in the 5 to 20 watt class.

a) Installation with 99'er

(1) No internal modification is required to either the APOLLO or the standard 99'er transceiver. Two wires must be soldered between pins 11 and 6 of the female AC plug furnished with the 99'er. This provides energizing power for a small external relay then used to control TRANSMIT – RECEIVE functions of the APOLLO. See figure below.



(2) Connect the coaxial cable supplied with the APOLLO between J1 on the APOLLO and the ANT receptacle on the 99'er.

(3) Connect dummy load (recommended initially) or antenna to ANTENNA receptacle on APOLLO.

(4) Tune 99'er for maximum output in normal manner. Note that RELATIVE OUTPUT meter on APOLLO will behave identically with output meter on 99'er (except with different scale factor).

(5) Observe that relay #171-001 is actuated whenever 99'er is in transmit mode.

(6) Connect AC line cord from APOLLO to suitable power source.

(7) Apply filament power to APOLLO by means of FILAMENT switch.

(8) On initial installation BIAS adjustment on APOLLO must be made as follows:

a. Remove jumper temporarily from J2 and J3 at rear of APOLLO.
b. Turn HIGH VOLTAGE ON.
c. Turn 99'er to SEND position.
d. Adjust BIAS control at rear of APOLLO for 70 - 75 ma PLATE CURRENT reading.
e. Switch 99'er to RECEIVE.
f. Observe that PLATE CURRENT drops to zero.
g. Switch OFF HIGH VOLTAGE.
h. Reconnect jumper at J2 - J3.

b) APOLLO TUNE-UP with 99'er

(1) Adjust 99'er for maximum output in "straight through" mode, (i.e. APOLLO connected but HIGH VOLTAGE OFF).

(2) Set AMPLIFIER PLATE LOAD TO full counter clockwise, minimum loading, #1 position.

(3) Set AMPLIFIER PLATE TUNE to full clockwise, #10 position.

(4) Set GRID control to full counter clockwise, #1 position.

(5) Apply high voltage to APOLLO (by momentarily depressing HIGH VOLTAGE ON switch).

(6) Switch 99'er to SEND position.

(7) Adjust APOLLO GRID control for 180 ma PLATE CURRENT.

(8) Adjust AMPLIFIER PLATE TUNE control for minimum plate current.

(9) Adjust both AMPLIFIER PLATE controls together for maximum RELATIVE OUTPUT while maintaining PLATE CURRENT between 180 and 200 ma by means of APOLLO GRID control.

(10) Final adjustment should produce between 60 and 75 watts carrier output from APOLLO with approximated 180 ma plate current and neither AMPLIFIER PLATE control at an extremity of its range.

(11) 99'er modulation should be adjusted so that APOLLO plate current shows the slightest upward movement on modulation peaks.

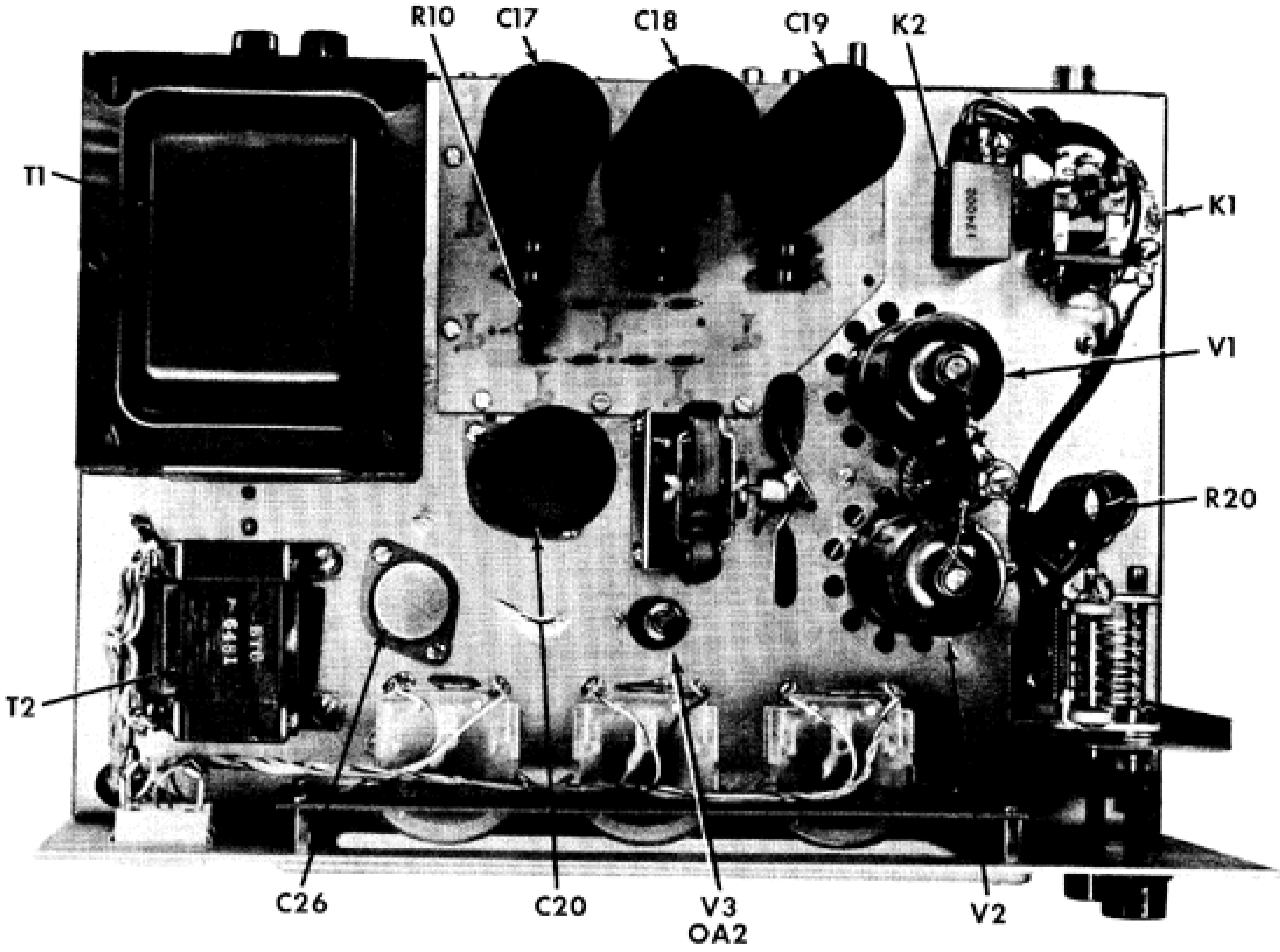


FIG. 3 – APOLLO CHASSIS VIEW

IV. THEORY OF OPERATION

A. Control Circuit Component Functions

1. S1 FILAMENTS: S1 applies 115 VAC via Fuse, F1 to primary of T2; FILAMENT pilot lamp, 12; Blower, BL1 and normally closed S3. Also applies unfused 115 VAC to ACCESSORY socket J5.

2. S2 HIGH VOLTAGE ON: S2 is a normally open, momentarily closed type switch arranged to initially energize relay coil of K3.

3. S3 HIGH VOLTAGE OFF: S3 is a normally closed, momentarily open type switch arranged to remove energizing voltage from relay coil of K3.

4. K1, K2: K1 is a double pole double throw relay arranged to work in conjunction with K2, a four pole double throw relay. All TRANSMIT — RECEIVE switching functions are performed by the six poles of these two relays in the following manner:

   a) CONDITION #1 - K1 and K2 both de-energized.

      (1) ANTENNA J4 is connected to J1 and thus back to VENUS (or other transceiver, receiver-transmitter unit). Relay contacts K1B and K2A serve this purpose.

      (2) J2 and the pi-network output are both grounded by relay contacts K2B and K1A respectively.

      (3) Cut off bias is applied to V1 and V2 by action of K2C. (See BIAS)

      (4) External equipment requring "closed circit logic" is activated by K2D closure of terminals 2; and 3 on TS-1.

   b) CONDITION #2 - K1 and K2 both energized.

      (1) ANTENNA J4 is connected to pi-network output via K1B and ground is removed with K1A.

      (2) K2A applies drive from VENUS (via J2, J3 and jumper or attenuator) to grid circuit of APOLLO.

      (3) K2B and K1A perform cable grounding functions to prevent feedback via RF cables.

      (4) K2C grounds R31 and establishes proper operating bias for V1 and V2.

      (5) External equipment requiring "closed circuit logic" is activated by K2D closure of terminals 2 and 4 of TS-1.

CONDITION 1 is the normal receiving function and also exists when the APOLLO is on "stand by" (Filaments on but HIGH VOLTAGE OFF) even when the VENUS (or other driver) is transmitting. This provides the ability to switch between low power and high power instantaneously. CONDITION 2, of course, is the normal transmit mode for the APOLLO and occurs when HIGH VOLTAGE is on and the external control circuiting closes terminals 5 and 6 of TS-1.

5. K3: K3 is a 3 pole, double throw relay whose principal function is to activate the primary of high voltage transformer T1 through closure of contacts K3A.

   a) Contacts K3B are utilized to furnish holding power for the coil of K3 after initial closure via S2.

   b) Contacts K3C are arranged to prevent energization of K1 and K2 when the APOLLO is in its "standby" mode.

6. K4: K4 serves as a protective relay and is energized when excessive plate current occurs. The pull in point is adjustable by means of R20, OVERLOAD ADJUSTMENT. This adjustment should be set for 600 ma.

   Contacts on K4 are normally closed and when abnormal DC plate current energizes K4 coil they act to remove voltage from K3 coil. This, of course, removes primary power from the high voltage supply, resets K4 and awaits reactivation by S2.

B. Power Supply Component Functions

1. T1, X1, CR9, CR10: T1 is a dual secondary transformer furnishing two high voltage outputs for plate and screen supplies. CR9 and CR10 are silicon diodes connected in a full-wave center-tapped configuration. X1 contains silicon diodes in a full-wave bridge configuration. Normal load outputs from these supplies are 265 V and 1500 V respectively.

2. R10, C17, C20, R11, R18, C21: R10 is a non-linear resistive element whose principal function is to prevent excessively high initial charging current. Its characteristics are such as to exhibit a high resistance at high current and drops to less than 10 ohms at normal current of 100 to 400 ma.

   C17 - C20 combined with divider-bleeder resistors R11 - R18 furnish an effective 40 MFD output capacitor on the plate supply yielding the type of dynamic regulation required for a linear amplifier.

   C21 can be considered as an AC by-pass capacitor shunting the overload relay, (K4) and the PLATE CURRENT meter.

3. C23, R21, R22, R23, M3, CR11, C24: These components combine to provide a reliable means of measuring and monitoring DC plate current of V1 and V2. R21 can be considered as a shunt properly matched with R22, R23 and

the .5 ohm internal resistance of M3 to provide a 3 to 1 current division in the two paths to ground. That is, at 400 ma from the HV supply, current through R21 is 300 ma and through R22, R23 and M3 is 100 ma. Under these conditions negligible current flows through protective diode CR11 because of its typical silicon junction characteristics. Indicated current on M3 is 400 ma since its scale calibration to coil current ratio is 4 to 1.

At 800 ma DC plate current (200 ma through R22 et al) sufficient voltage drop occurs (.2 x 1.2 + .5 = .34 volts) across CR11 to cause it to begin to conduct and effectively shunt any further increases in current. This action produces insignificant errors in readings of M3 for plate currents below 650 ma and provides virtually complete burn out protection for M3 at currents in excess of 5 amperes.

C23 and C24 furnish RF and AC protective by-passing for the meter components.

4. R24, R25, R34, C25, C31, R26, V3: These components serve as a convential AC filter, DC regulator and AC regulator for the screens of V1 and V2. Nominal regulated output voltage across C31 is 180 VAC.

5. T2: T2 is a three secondary transformer furnishing cathode heater supply for V1 and V3, bias voltage (in conjunction with CR13, C28, etc.) I3 and I4 are supplied by this same winding.

6. CR12, C26, R27, R28, R29, R30, R31: These components comprise a conventional half wave rectifier, filter system with adjustable (by means of R30) negative output. When the bottom of R31 is grounded (by K2C) voltage between the arm of R30 and ground can be varied from -48 volts to -106 volts. When the bottom of R31 is lifted (K2C in receive mode) the arm of R30 rises to approximately -150 volts and biases V1, V2 sufficiently beyond cut-off to preclude noise generation.

7. CR13, C28, R32: These components serve as a conventional half wave rectifier and filter to furnish activating power for K1 and K2. Voltage across C28 is 18 volts without load and approximately 14 volts when K1 and K2 are energized.

C. RF Circuit Description

1. The RF section of the APOLLO employs two type 8236, high perveance, graphite anode tetrodes in parallel as Class AB$_2$ amplifiers.

2. Pi-networks are employed in both grid and plate circuits. The input network consisting of C1, L1, C4, R1 and R33 matches between a nominal 50 ohm driving source and 900 ohm load. Virtually all of the resistive termination to this network is represented by R1 and R33. The input capacity of the tubes forms the output (high impedance) element of the pi-network. Capacitor C1 is made variable to establish resonance over the useable frequency range of 49.8 - 51.5 MC. For operation at fre-

quencies above or below this range suitable modification must be made to L1.

3. C4 is a blocking capacitor to prevent grid bias from appearing on input cables. C5 is an RF by pass.

4. M1 is employed to facilitate tune-up and monitor operation. The amplifier is normally operated just slightly above Class AB_1 in that drive peaks are permitted to reach approximately 2 ma DC grid current.

5. L2/R2 and L3/R3 are parasitic suppressors in the control grid leads of V1 and V2.

6. The plate circuit pi-network consists of C2 and C3 (AMPLIFIER PLATE TUNE and LOAD respectively) and L6. C12 and C30 in parallel with C3 are chosen to provide the proper range in C3. Constants chosen permit operation over the frequency range 49.8 to 51.5 MC into reasonable load impedance ranges centered around 50 ohms. Where operation at other frequencies or into other load impedances is desired C12, C30 and/or L6 may require modification.

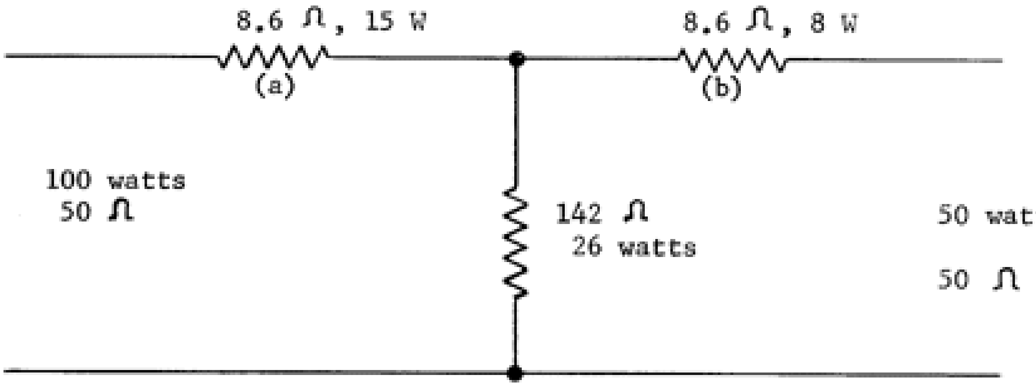
7. L7 is an RF choke used to shunt feed high voltage to the plate of V1 and V2. C10 and C29 are used to prevent this voltage from appearing at the output terminal.

8. CR14 and associated components are arranged to rectify a small sample of the RF voltage across J4 and activate M2, the RELATIVE OUTPUT METER. This meter is active at all times indicating relative output of the VENUS when the APOLLO is completely switched off or in stand by mode.

9. J6 is provided as means for scope monitoring the APOLLO (and exciter) output with a conventional scope.

ADDENDA

3 DB ATTENUATORS FOR APOLLO INPUT



PEP*	(a)	(b)	(c)
100-50	8 parallel 68 Ω, 2 W	4 parallel 33 Ω, 2 W	7 parallel 1000 Ω, 2 W
50-25	4 parallel 33 Ω, 2 W	3 parallel 27 Ω, 2 W	4 parallel 560 Ω, 2 W
25-12	3 parallel 27 Ω, 2 W	2 parallel 18 Ω, 2 W	2 parallel 270 Ω, 2 W

NOTE: Units suitable only for 60% duty cycle, where additional duty cycle is anticipated use next larger unit.